13.—*On the Dinosaurs of the Stormberg, South Africa.*—By R. Broom, M.D., D.Sc., C.M.Z.S.

(Plates XIV.–XVII.)

Though the first South African Dinosaurs were discovered nearly sixty years ago, only a very few forms have hitherto been described, and these from very fragmentary remains.

Massospondylus carinatus, Owen.

In 1853 Mr. J. M. Orpen, Government Surveyor, discovered on the farm Beaucherf, Harrismith, a series of fairly large bones, and on the Harrismith commonage some smaller bones. These he forwarded to his father, the Rev. C. E. H. Orpen, of Colesberg, who transmitted them to Professor Owen. Owen apparently believed that all the bones came from one spot, and regarded them as belonging to these different genera and species which he named *Massospondylus carinatus*, *Pachyspondylus Orpenii*, and *Leptospondylus capensis*. No figures were given by Owen, but in 1895 Seeley redescribed and figured the principal remains, and regarded all as probably belonging to one species. Huene has recently very fully described and figured all the specimens, and agrees with Seeley that all belong to one species, but recognises a larger and a smaller individual. Mr. J. M. Orpen has recently given me particulars of the finds, and it is quite evident that there are two individuals represented, and probably only two. Unfortunately the remains of the smaller individual are very unsatisfactory, and Owen's genera *Pachyspondylus* and *Leptospondylus* are founded on vertebræ so imperfect that it is doubtful if either can be regarded as satisfactory types even if distinct from *Massospondylus*, and it is pretty certain one at least is founded on remains of *Massospondylus carinatus*. The small individual possibly belongs to the species I am describing as *M. harriesi*.

EUSKELESAURUS BROWNI, Huxley.

ORINOSAURUS CAPENSIS, Lydekker.

Never was there a man with a greater genius for collecting than Mr. Alfred Brown, of Aliwal North, and though Aliwal is by no means a rich district, his perseverance during over fifty years has been rewarded by the discovery of a large number of most interesting remains. But valuable as his work has been, we who know the man have some idea of what he would have done had he received more encouragement.

When he discovered the large bones of *Euskelesaurus* he spent a very considerable sum in excavating and having them sent to England. The first consignment was sent to Sir R. Murchison, who handed them over to Huxley for description. Huxley recognised the remains as those of huge Dinosaurs, and named the principal form *Euskelesaurus browni*. A large crushed tibia he described as *Orosaurus*. A second consignment was sent to Murchison, and the receipt of it duly acknowledged, but this lot of bones was apparently lost. Brown sent his next consignment to Paris, where it was described and figured by Fischer. A still later collection was sent to Vienna. Mr. Brown informs me that all these collections were got at the same spot, so that while it is manifest that they are the remains of two individuals, it is probable that the Vienna remains are parts of the type of *Euskelesaurus browni*. He further informs me that the collection which has been lost "contained chiefly the remains of large limbs and other massive bones."

Seeley, in 1894, redescribed and figured all the principal remains of *Euskelesaurus*, including a further number of bones that had been obtained by Mr. Brown. In addition, he describes a lower jaw and cervical vertebra obtained at Kraai River which are doubtfully referred to *Euskelesaurus browni*. In 1905 Mr. Brown sent to the South African Museum some further remains from Kraai River, also believed to be *Euskelesaurus*, but when the remains were developed it was found that they belonged to a new animal which was not even a Dinosaur. This new type I named *Erythrosuchus africanus*. When the collection of fossils given by Dr. Kannemeyer to Professor Seeley was worked up, it was found to contain much of the skeleton of another specimen of *Erythrosuchus*, including the greater part of the skull, and when the mandible was compared with that supposed to be of *Euskelesaurus*, the two were seen to be practically similar. There is thus no doubt that the mandible figured by Seeley is really

the mandible of *Erythrosuchus* and not that of *Euskelesaurus*. And there is reason to suppose that the short cervical vertebra is also that of *Erythrosuchus*.

Orosaurus of Huxley was changed to *Orinosaurus* by Lydekker, and the specific name *capensis* added. Huene has fully re-examined all the *Euskelesaurus* remains, and gives a restoration of the animal. He regards *Orinosaurus capensis* as but another species of *Euskelesaurus*.

Hortalotarsus skirtopodus, Seeley.

Massospondylus browni, Seeley.

Hortalotarsus skirtopodus is founded on a fragment of the hind limb of a small Dinosaur from Barkly East. Originally most of the skeleton was in the rock, and it was regarded by the farmers as the skeleton of a Bushman, but it is said to have been destroyed through fear that a Bushman skeleton in the rock might tend to weaken the religious belief of the rising generation. Huene is of opinion that *H. skirtopodus* really belongs to the European genus *Thecodontosaurus*.

In 1905 I described the hind limb, with pelvis and some vertebræ of a specimen which I thought might be referred to *Hortalotarsus skirtopodus*, thinking the differences in size might be due to this specimen being immature. If, however, Huene is right in regarding *H. skirtopodus* as really a species of *Thecodontosaurus*, and there is little doubt that *Hortalotarsus* is at least allied to *Thecodontosaurus*, then the South African Museum specimen which I referred to *Hortalotarsus* must be placed in a new genus.

Massospondylus browni is, like *Hortalotarsus skirtopodus*, only known from a few remains. The femur, however, is well preserved, and seems to show that the species belongs to *Thecodontosaurus*, as is maintained by von Huene.

Gyposaurus capensis, g. et sp. nov.

This new genus and species is founded on the South African Museum specimen which I had referred to *Hortalotarsus skirtopodus*. The two animals are of practically the same size, but the pelvis and femur of the South African Museum specimen are very different from those of *Thecodontosaurus*, and must belong to a new genus.

Among the chief characteristics of this new genus the most noteworthy is the remarkable shape of the ilium. The iliac crest has a greater anterior extension than in any other known carnivorous

Dinosaur, and the preacetubular process relatively small. The femur is relatively stout, and has the *trochanter quartus* small and high up, and the *trochanter major* almost rudimentary.

All the remains of any importance are figured in a paper in the Trans. South African Phil. Soc., vol. xvi., pt. 3, 1906.

Gryponyx africanus, g. et sp. nov.

Recently there was discovered on the farm of Mr. J. L. Harries, Foutani, near Fouriesburg, in the Orange Free State, a considerable number of remains of Dinosaurs, and the more accessible have been excavated by Mr. A. R. Walker, of the South African Museum, with Mr. Harries' assistance. All the remains are from the Red beds.

The most important is a large carnivorous Dinosaur allied to *Plateosaurus* of Europe, but apparently belonging to a new genus and species which I have named as above. The anterior half of the animal has been lost, but Mr. Walker and Mr. Harries were successful in obtaining both the right and left manus, most of the dorsal vertebræ, the whole pelvis, both hind limbs, and the right pes. The greater part of the tail had to be left in the rock, as, owing to its passing straight into the cliff, it could not have been all removed except at very great expense.

The vertebræ have not yet been completely developed, but so far as can be seen they appear to agree fairly closely with those of *Plateosaurus*.

The radius and ulna are both well preserved in their distal halves, but imperfect proximally. The shapes of the distal ends are seen in the figures.

In the carpus there are seven elements, and though there is some doubt concerning the determination of one or two, most can be determined with certainty and the others with much probability. The 1st, 2nd, and 3rd distal carpalia are in undisturbed relations with the metacarpals, and there can be practically no doubt about them. All the proximal carpals are small, and in the specimen three lie below the end of the radius. These I believe to have been displaced and to be the radiale, the intermedium, and the ulnare. While this seems to be the natural determination of the three proximal elements, it is confirmed by the fact that they can be fitted in their natural position on the proximal side of the distal carpalia. The 7th element is small, and from its situation by the side of the 3rd carpale it is evidently the 4th carpale.

Assuming these determinations to be correct the elements may be described as follows:—

Radiale.—A very small lenticular bone measuring 10 mm. in length and about 4 mm. in greatest thickness. It has probably been imbedded in cartilage, and lay in a concavity on the upper side of the inner half of the large 1st distal carpale.

Intermedium.—A moderate-sized bone, which appears to have lain on the proximal side of the outer fourth of the 1st carpale.

Ulnare.—This is roughly about the same size as the intermedium. The outer and under side is concave as if to fit a part of the cartilage of the 4th carpale. It appears to have articulated with the 2nd and 3rd carpalia.

1st carpale.—This is a very large bone which distally articulates with most of the end of the large 1st metacarpal and with half of the proximal end of the 2nd carpale. Proximally it articulates with the largely cartilaginous radiale and the intermedium. It seems, however, pretty certain that the lower half of the proximal end articulated with the radius when the hand was flexed. The greatest length of the bone is 56 mm., and the greatest thickness between the dorsal and ventral sides about 35 mm. Between the proximal and distal surfaces the greatest measurement is 20 mm.

2nd carpale.—This is a little less than half the size of the 1st carpale. On the dorsal side it is narrow, and fits in between the 1st carpale and the end of the 2nd metacarpal, but on the palmar surface it is broad and underlies a part of the metacarpal.

3rd carpale.—This appears on the dorsal surface larger than the 2nd, but on the palmar surface rather smaller. On the ulnar and proximal side there is a small concavity which probably articulated with the large and mainly cartilaginous 4th carpale.

4th carpale is a small flattened spheroidal bone about 12 mm. in length and 7 mm. thick. It was probably imbedded in a large amount of cartilage.

The 1st metacarpal is a large bone, measuring in greatest length 64 mm. and about 54 mm. in width. The distal articular end is divided into a large portion on the ulnar side and a small portion on the radial. The 1st phalanx of the 1st digit has a very broad proximal end measuring about 47 mm. Distally there is a bilobed articulation for the large claw, which is so arranged that the claw must have pointed downwards and towards the radial side. The length of the bone is 63 mm. The 2nd phalanx is the huge claw of the pollex. The proximal end measures 52 mm. in depth and about 28 mm. in greatest width. There is a very large bony process for

the insertion of the flexor tendon. The curve on the upper side of the claw is part of a circle with a radius of about 60 mm. On the radial side is a marked vascular groove, which runs nearly to the point. The claw appears to have been able to move on the phalanx through about 60°. The greatest length is about 105 mm.

The 2nd metacarpal measures 80 mm. in length, and 39 mm. in breadth at its proximal end and 35 mm. at its distal. It articulates proximally with the small 2nd carpale. The upper side of the distal end has the articular surface extending back for 20 mm., so that the 1st phalanx could have been bent back to about 75°.

The 1st phalanx is a short powerful bone measuring 42 mm. in length. At the proximal end it measures 30 mm. in width and 28 mm. in depth. The distal end measures 28 mm. in width and 20 mm. deep.

The 2nd phalanx measures 35 mm. in length. The proximal end is 25 mm. by 25 mm., and the distal 23 mm. by 20 mm.

The terminal phalanx probably measured 65 mm. in length and the proximal end 20 mm. by 32 mm.

The 3rd digit is rather more slender than the 2nd. The metacarpal is 75 mm. long. The proximal end is 38 mm. wide, and the distal end 30 mm. The articular surface on the distal end does not extend down the upper surface as in the 2nd metacarpal, and the 1st phalanx could probably not bend back more than 25°, nor could it have been flexed more than 30°.

The following are the measurements of the phalanges of the 3rd digit:—

	Length.	Proximal Width.	Proximal Depth.	Distal Width.	Distal Depth.
1st phalanx	32 mm.	24 mm.	18 mm.	22 mm.	13 mm.
2nd phalanx	25 ,,	20 ,,	18 ,,	18 ,,	13 ,,
3rd phalanx	24 ,,	17 ,,	17 ,,	16 ,,	13 ,,
Claw phalanx ...	43 ,,	14 ,,	20	—	—

In the 3rd digit very little extension beyond the straight was possible, and the amount of flexion was limited to about 45° in the case of the claw, and about 30° in the case of the phalanges.

In the best-preserved foot the 4th and 5th digits seem to have been affected with arthritis, and the phalanges are deformed. In this left foot the 4th digit has only one phalanx and the 5th two. In the right foot the 3rd digit has evidently had the toe cut off beyond the 1st phalanx, as it alone remains, and the distal articular

surface has been completely destroyed. The 4th digit is apparently complete and uninjured, but has only three phalanges, and the last is rudimentary and had no claw. The 5th digit in both feet has only two phalanges.

The digital formula for the manus would thus be 2, 3, 4, 3, 2.

The following are the measurements of the bones of the 4th and 5th digits—the former taken from the left and the latter from the right foot :—

	Length.	Proximal Width.	Proximal Depth.	Distal Width.	Distal Depth.
4th metacarpal ...	50 mm.	35 mm.	— mm.	26 mm.	— mm.
1st phalanx	25 ,,	20 ,,	17 ,,	18 ,,	11 ,,
2nd phalanx	19 ,,	15 ,,	12 ,,	13 ,,	7 ,,
3rd phalanx	rudimentary.				
5th metacarpal ..	38 mm.	34 ,,	— ,,	26 ,,	—
1st phalanx	26 ,,	23 ,,	18 ,,	17 ,,	10 ,,
2nd phalanx	rudimentary.				

The pelvis is fairly well preserved, but a little distorted. The pubes and ischia of both sides are complete, and the greater part of both ilia are present. In fact, the only part that requires to be restored is the tip of the anterior process of the iliac crest. The right ilium has the base of the anterior process preserved, and the left ilium the greater part of the iliac crest; so that the small missing part can be restored with much probability.

The iliac crest is much straighter than in *Plateosaurus* or *Teratosaurus*, and the anterior iliac spine is unusually small. The acetabulum is large, and the portions of the ilium which form both its anterior and posterior walls are well developed.

The pubes and the ischia form a complete symphysis, with no opening of any sort in it from the front of the pubis to the posterior end of the ischium. The upper end of the pubis is large and fairly flat and forms a wide angle with its neighbour. It has a large nearly round pubic foramen. The anterior portion of the pubis is broad and flat, the two together at their narrowest part measuring 122 mm. across. The greatest length of the pubis 435 mm.

The ischium is rather shorter than the pubis. In general shape it fairly resembles that of *Sellosaurus* and *Plateosaurus*. Its anterior part has a long articulation with the pubis extending from the acetabulum to the symphysis. The greatest length of the ischium is 405 mm. The greatest measurement across the two ischia where

they meet the ilia is 185 mm., and the narrowest measurement across the two bones near the middle of the posterior portion is 50 mm.

Both femora are nearly completely preserved, but both are much crushed and in opposite ways. The femur resembles pretty closely that of *Plateosaurus*, differing so far as can be seen only in the trochanter minor being smaller and in the third trochanter being more to the inner side of the bone. The one femur measures 535 mm. in length and the other 550 mm.

The tibia has a larger head than appears to be the case in *Plateosaurus*, but otherwise presents no specially interesting features. The total length of the bone is 447 mm., and the proximal end measures 163 mm. by 71 mm.

The fibula is a long slender bone, which is slightly expanded at its distal end and much flattened out at its proximal end. It measures 413 mm. in length.

The tarsus is not well preserved. The tibiale is of the usual shape and has been pretty closely united to the tibia.

The pes is complete, but some of the bones are slightly crushed.

The 1st metatarsal is a rather flat oblong bone. The upper end fits into a hollow on the inner side of the 2nd metatarsal. The greatest breadth of the proximal end is 59 mm. and the greatest thickness 21 mm. The total length of the bone is 112 mm. The distal end is somewhat oblique. It measures in greatest breadth 60 mm. and in greatest thickness 26 mm.

The 2nd metatarsal has an irregular quadrangular proximal end. The breadth across the plantar surface is 50 mm. and across the dorsal probably 30 mm. The depth of the proximal end is across the most remote angles about 74 mm. The greatest length of the bone is 187 mm. The distal end measures in greatest breadth 64 mm.

The 3rd metatarsal has a narrow irregularly triangular proximal end measuring about 40 mm. by 62 mm. The total length measures 203 mm. The distal end measures 50 mm. across.

The 4th metatarsal is much flattened. The proximal end measures 78 mm. across by about 36 mm. deep. The length of the bone is 166 mm. and the distal end measures 52 mm. in breadth.

The 5th metatarsal is a short irregular triangular bone. The proximal end measures 66 mm. in breadth, and total length of the bone is 113 mm.

The following are the measurements of the phalanges :—

		Length.	Proximal Width.	Distal Width.
1st digit	1st phalanx.....	71 mm.	43 mm.	38 mm.
	2nd phalanx.....	about 110 ,,	34 ,,	—
2nd digit	1st phalanx.....	72 ,,	42 ,,	40 ,,
	2nd phalanx.....	53 ,,	37 ,,	35 ,,
	3rd phalanx.....	about 99 ,,	26 ,,	—
3rd digit	1st phalanx.....	71 ,,	53 ,,	38 ,,
	2nd phalanx.....	52 ,,	40 ,,	31 ,,
	3rd phalanx.....	45 ,,	35 ,,	28 ,,
	4th phalanx.....	about 77 ,,	30 ,,	—
4th digit	1st phalanx.....	57 ,,	41 ,,	35 ,,
	2nd phalanx.....	44 ,,	35 ,,	28 ,,
	3rd phalanx.....	38 ,,	30 ,,	25 ,,
	4th phalanx.....	34 ,,	29 ,,	25 ,,
	5th phalanx.....	about 68 ,,	24 ,,	—
5th digit	1st phalanx.....	rudimentary.		

Perhaps the most interesting point in connection with the phalanges is the fact that the claw of the 2nd digit has got a sharp outer side and a rounded inner side. This same condition is found in *Massospondylus harriesi* and *Ætonyx palustris*. There seems to be little doubt that the digit had a claw with a combing or scraping edge such as is seen in many birds, and the question arises, What had the Dinosaur to comb? We seem justified in concluding that the dermal covering was probably of a different nature from the scales seen in lizards and crocodiles. As the combing claw is only on the 2nd digit it had clearly nothing to do with scraping the ground or digging, and from analogy with the bird and marsupials almost certainly was used for cleaning the skin and scales. Probably the skin had elongated scales with soft skin between. This would admit of greater freedom of movement and, like the feathers of birds, would require to be cleaned after the animals had been hunting their prey on the muddy banks of the lakes.

Massospondylus harriesi, sp. nov.

This Dinosaur, which was also discovered on the farm of Mr. Harries, resembles *Massospondylus carinatus* sufficiently closely to suggest the advisability of placing it at least provisionally in the same genus. The remains consist of an imperfect humerus, a nearly perfect radius and ulna, and a perfect manus, as well as portions of the femur and tibia, and a number of toe bones all of one individual, and the perfect pes of another individual.

The humerus has lost the upper third, but the lower two-thirds, including delto-pectoral ridge, is perfect. In general shape it resembles considerably the humerus of *Plateosaurus reinigeri*, but is only about half the size. The narrow part of the shaft is relatively a little thicker in the present species, the lower end of the bone is broader and the delto-pectoral ridge is narrower, and is more directly continuous with the head of the bone. The following are some of the principal measurements :—

Probable greatest length	220 mm.
Breadth at distal end	77 ,,
Width at narrowest part of shaft	32·5 ,,
Width at top of pectoral ridge.....	72 ,,
From lower end of pectoral ridge to furthest part of distal end	125 ,,

The left ulna is almost perfect, only a small portion of the proximal end being lost, and the left radius is even better preserved. This is the more satisfactory in that in *Massospondylus carinatus* neither the radius nor ulna is known, and in the other Triassic Dinosaurs the bones of the forearm are rarely well preserved. In *Pachysaurus ajax* both radius and ulna are known, but they are considerably distorted. In *Plateosaurus quenstedti* they are better preserved. In *Massospondylus harriesi* the radius is nearly straight, slightly broadening at the upper and lower ends. The upper end has a deep concavity for the condyle of the humerus. On the posterior and inner side of the upper third is an oblique groove, probably for the attachment of the biceps or humero-antibrachialis. The lower end of the bone is curved outwards a little, and the large articular surface looks somewhat forwards.

The ulna is in its upper half nearly twice as broad as the radius. The lower end has the same peculiar twist already seen in *Gryponyx*, but here it is more marked. The distal fourth of the bone is rotated about 40° to the right.

The following are the principal measurements of the bones :—

Greatest length of radius	probably 128 mm.
Width at proximal end	35 ,,
Width at distal end	31 ,,
Width in middle of shaft	19 ,,
Greatest length of ulna	probably 134 ,,
Width at proximal end	57 ,,
Width at distal end	41 ,,
Width in narrowest part of shaft.....	25 ,,

The carpus is imperfect and the rudimentary phalanx of the 5th digit lost, but otherwise the whole of the left manus is perfect, and the bones are so well preserved that it is possible to fit all the bones in true position so that a better idea of the shape of the hand can be obtained than in any other known specimen.

The 1st carpale is concavo-convex in front, like the saddle-shaped end of the centrum of the vertebra of a bird, and convex behind. It measures 36 mm. by 24 mm.

The 2nd carpale is a curved bone with a sharp upper end and a broad square lower end. It fits in between the 1st metacarpal, the 1st carpale, and the 3rd carpale. Its greatest depth is 24 mm., and the lower end measures 13 mm. by 13 mm.

The 1st metacarpal is short and broad, and is remarkable for the very small size of the inner distal condyle. The greatest length is 39 mm. and the proximal breadth 36 mm.

The 1st phalanx of the 1st digit measures, greatest length 42 mm., proximal breadth 31 mm., distal breadth 27 mm. It is much less twisted than in *Gryponyx*, so that when the digit is flexed the claw passes nearly directly downwards. When extended, however, the claw is directed about 45° inwards. The claw measures 72 mm. in length, and the proximal end measures 38 mm. by 21 mm.

The measurements of the other metacarpals and phalanges are as follows :—

	Greatest Length.	Proximal Width.	Distal Width.
2nd metacarpal.....	49 mm.	32 mm.	27 mm.
1st phalanx	28 ,,	23 ,,	19 ,,
2nd phalanx	22 ,,	17 ,,	15 ,,
Ungual phalanx ...	45 ,,	proximal end	22 × 13
3rd metacarpal	45 ,,	28 mm.	19 mm.
1st phalanx	18 ,,	16 ,,	13 ,,
2nd phalanx	16 ,,	14 ,,	13 ,,
3rd phalanx	15 ,,	12 ,,	11 ,,
Ungual phalanx ...	27 ,,	proximal end	13 × 10
4th metacarpal	37 ,,	21 mm.	13 mm.
1st phalanx	15 ,,	11 ,,	9 ,,
2nd phalanx	10 ,,	8 ,,	6 ,,
3rd phalanx	10 ,,	6 ,,	—
5th metacarpal	29 ,,	22 ,,	17 ,,
1st phalanx	16 ,,	14 ,,	11 ,,
2nd phalanx	rudimentary, lost.		

From the structure of the manus it is quite manifest that it could rest on the ground and support the weight of the body. In my opinion the foot did not rest, as believed by von Huene, on the palm, but was quite as digitigrade as the hind foot. My reasons for this conclusion are that it is impossible to fit the metacarpals together satisfactorily so that they could lie on a flat surface, whereas if they are arranged in digitigrade fashion they fit accurately, the ends resting on one plane.

When the foot is placed on the ground the 1st large digit probably bears none of the weight, though possibly the side of the toe may touch the ground. The large claw curves inwards, and may also touch the ground, though it bears none of the weight. The balls of the 2nd, 3rd, 4th, and 5th toes, with probably a palmar pad and the short 4th and 5th digits carry all the weight. The 2nd digit is doubtless considerably extended, so that it makes an angle of about 80° with the metacarpal, and the claw is flexed so that it may just touch the ground. The 3rd digit is less extended, and probably to a considerable extent rests on the ground. The penultimate phalanx is more extended and the short claw flexed. The 4th digit has no claw and rests flat on the ground. The short 5th digit, which has a stout proximal phalanx and probably a single rudimentary distal one, also rests on the ground.

When the animal is standing on its hind feet the digits are probably more flexed, and when catching its prey all three claws can be brought to work together by flexion, but for satisfactory prehension it is necessary for the two hands to work together. Probably the animal caught its prey with its hands and killed and tore it up by blows from one or other of the hind feet.

The femur is imperfect, all the portion above the lower trochanter being lost. The lower half is considerably stouter in relation to its length than in either *Gryponyx*, *Massospondylus carinatus*, or *Plateosaurus*. It is, as preserved, somewhat distorted, but the measurements are as follows:—

Distal end to lower end of trochanter.....	155 mm.
Width of distal end as crushed	114 ,,
Probable width of uncrushed	90 ,,
Greatest width of narrowest part of shaft	45 ,,

The proximal end of the left tibia is preserved in good condition It measures 102 mm. by 52 mm.

The whole of the pes except the tarsal elements is known in perfect condition, though probably the metatarsals are slightly crushed proximally.

The 1st metatarsal is 87 mm. in length, the proximal end is 40 mm., and the distal end 36 mm. wide. The upper end fits into a deep concavity on the inner side of the 2nd metatarsal.

The 2nd metatarsal has the proximal end irregularly quadrangular, with the one diagonal considerably longer than the other. The greatest width is 63 mm. The greatest length is 138 mm., and the distal end measures 39 mm. across.

The 3rd metatarsal has the proximal end irregularly triangular. The greatest measurement across the upper end is 45 mm. The total length of the bone is 154 mm., and the distal end measures 38 mm. in width.

The 4th metatarsal has the head greatly flattened—partly, perhaps, increased by crushing. The greatest length of this end is 55 mm. The total length of the bone is 135 mm., and the width of the distal end is 31 mm.

The 5th metatarsal measures 75 mm. in length. The proximal end is 44 mm. and the distal end 18 mm. across.

On the whole there is much resemblance between the metatarsals of *Massospondylus harriesi* and those of *Teratosaurus trossingensis*, though the latter is about twice as large.

The following are the principal measurements of the phalanges :—

	Length.	Proximal Breadth.	Distal Breadth.
1st digit 1st phalanx.....	45 mm.	32 mm.	25 mm.
Claw.....	about 68 ,,	21 ,,	— ,,
2nd digit 1st phalanx..... ..	48 ,,	35 ,,	35 ,,
2nd phalanx.....	35 ,,	32 ,,	27 ,,
Claw.....	62 ,,	24 ,,	—
3rd digit 1st phalanx.....	48 ,,	38 ,,	33 ,,
2nd phalanx.....	35 ,,	30 ,,	27 ,,
3rd phalanx.....	27 ,,	28 ,,	23 ,,
Claw.....	51 ,,	23 ,,	—
4th digit 1st phalanx.....	42 ,,	31 ,,	27 ,,
2nd phalanx.....	30 ,,	25 ,,	24 ,,
3rd phalanx.....	25 ,,	23 ,,	21 ,,
4th phalanx.....	22 ,,	19 ,,	19 ,,
Claw.....	48 ,,	17 ,,	—
5th digit 1st phalanx.....	17 ,,	17 ,,	—

ÆTONYX PALUSTRIS, g. et sp. nov.

In the collection made by Mr. Walker are the remains of a third species of carnivorous Dinosaur much smaller than either of the other two species, and differing from both considerably in the proportions of the limbs. There are preserved the following bones: A few imperfect dorsal vertebræ, a good scapula and coracoid, a good humerus, a good radius and imperfect ulna, the greater part of each manus, the upper end of one tibia, and the almost complete right pes.

The dorsal vertebra agrees in most respects with those of other carnivorous Dinosaurs. The centrum is much flattened and agrees closely with that of *Cœlophysis*, and apparently with *Anchisaurus*. It measures in length 45 mm., and in its narrowest middle part 11 mm. across. The greatest depth of the articular end is 30 mm. The length from the one zygapophysis to the other is about 57 mm., and the measurement from the one transverse process to the other about 37 mm.

The scapula is well preserved, only a very little being lost from its upper end. In general shape the bone resembles that of *Massospondylus* more than that of any other known type. The lower end is very broad, being nearly three times as broad as the middle of the bone is narrow. As preserved the scapula measures 185 mm. in length, and possibly originally measured 210 mm. The width of the narrowest part of the bone is 30 mm. and the width of the lower end 87 mm.

The coracoid is almost perfect. It measures antero-posteriorly 102 mm. and in depth at the region of the foramen 58 mm.

The humerus is perfect except for a small fragment missing from both ends. It agrees pretty closely with the Plateosaurian type, but has the part below the delto-pectoral crest relatively rather shorter. The greatest length of the humerus is 174 mm. From the lower end of the delto-pectoral ridge to the upper end of the bone is 101 mm. The width of the lower end is 57 mm.

The radius and ulna are relatively very short. The radius measures only 96 mm. in greatest length.

The first distal carpal measures 28 mm. by 19 mm. and is 9 mm. thick. What are probably the 2nd and 3rd carpals are preserved, but as they are not in position the identification is doubtful.

The manus is fully preserved with the exception of the 3rd meta-

carpal, most of the 4th metacarpal, and the phalanges of the 4th and 5th digits.

The 1st metacarpal is in general shape much like that of *Massospondylus*, but differs in that its proximal outer corner ends in a point. In this it also differs from *Gryponyx*. The 1st phalanx differs from that of *Massospondylus harriesi* in being relatively longer and more slender.

The 2nd digit is relatively more slender than in *Massospondylus harriesi*, and the claw is unlike that of either *Massospondylus* or *Gryponyx*, about the same length as the penultimate phalanx. The claw is further remarkable from the fact that the vascular grooves meet each other on the upper side near the union of the middle and distal third, leaving the upper part of the claw separated from the lower, something like the horn of a hornbill.

The 3rd digit is a little shorter than the 2nd, and the phalanges are narrow and slender.

The 5th metacarpal is not unlike that of *Massospondylus harriesi*, but considerably smaller.

The following are the principal measurements of the bones of the manus:—

	Greatest Length.	Proximal Width.	Distal Width.
1st metacarpal	34 mm.	33 mm.	15 mm.
1st phalanx	35 ,,	28 ,,	21 ,,
Ungual phalanx ...	61 (approx.)	19 ,,	—
2nd metacarpal.....	42 mm.	26 ,,	22 ,,
1st phalanx	27 ,,	20 ,,	18 ,,
2nd phalanx	29 ,,	17 (approx.)	15 ,,
Ungual phalanx ...	32 (approx.)	11 mm.	—
3rd metacarpal missing.			
1st phalanx	19 mm.	14 ,,	13 mm.
2nd phalanx	15 ,,	12 ,,	11 ,,
3rd phalanx	16 ,,	11 ,,	11 ,,
Ungual phalanx ...	25 (approx.)	8 ,,	—
4th metacarpal and phalanges fragmentary or missing.			
5th metacarpal	26 mm.	20 mm.	15 ,,
Phalanges missing.			

The right hind foot is nearly complete, but the metatarsals have been broken across the middle, and the 4th is very badly crushed.

The following are the principal measurements of the bones :—

	Greatest Length.	Proximal Width.	Distal Width.
1st metatarsal	80 mm.	? crushed	30 mm.
1st phalanx	41 ,,	27 mm.	22 ,,
Ungual phalanx	58 (approx.)	20 ,,	—
2nd metatarsal	123 mm.	25 ,,	29 ,,
1st phalanx	44 ,,	33 ,,	28 ,,
2nd phalanx ...	34 ,,	25 ,,	24 ,,
Ungual phalanx	55 (approx.)	20 ,,	—
3rd metatarsal	130 mm.	26 ,,	35 (crushed)
1st phalanx	45 ,,	25 ,,	27 mm.
2nd phalanx ...	35 ,,	25 ,,	24 ,,
3rd phalanx.....	30 ,,	21 ,,	20 ,,
Ungual phalanx	48 (approx.)	18 ,,	—
4th metatarsal	117 (crushed)	44 (much crushed)	23 ,,
1st phalanx	35 mm.	Imperfect	24 ,,
2nd phalanx ...	28 ,,	24 (approx.) mm.	23 ,,
3rd phalanx.....	21 ,,	21 mm.	21 ,,
4th phalanx.....	23 ,,	18 ,,	18 ,,
Ungual phalanx	37 (approx.)	15 ,,	—
5th metatarsal	65 mm.	(crushed, imperfect)	

Rudimentary phalanx missing.

Geranosaurus atavus, g. et sp. nov.

The remains of this small Dinosaur were got by Mr. G. S. T. Mandy in the road-cutting near the summit of the Barkly Pass in Elliot. The collection of bones consists of badly crushed fragments of a skull with the anterior part of the lower jaw fairly well preserved, some slender birdlike hind-limb bones, and a number of very imperfect vertebræ. The vertebræ seem too large to have belonged to the skull, and there being thus some doubt about the bones being those of one animal I think it better to describe the jaw-bones alone and to make them the type.

As preserved, the lower jaw has the left dentary fairly complete with a considerable portion of the right and the predentary nearly perfect.

The predentary has its upper surface displayed, which is concave. It is 12 mm. long and the same in width. The outer and anterior edges are sharp and doubtless formed a horny beak.

The dentary as preserved measures 73 mm. in length, and there

is probably but little missing from the posterior end. The anterior half bears 9 teeth which have rounded roots in sockets. The teeth in the fragment of the maxilla have flat chisel-shaped crowns with the outer face feebly ridged. Probably those of the mandible were similar in this respect. The most remarkable thing about the dentition is that the most anterior of the teeth is larger than the others, and may be looked on as a canine. The total length of the dental series is 35 mm. Most of the teeth have a diameter of between 3 and 4 mm., but the anterior tooth has a diameter of 5 mm.

The specimen is from the Cave sandstone of the Stormberg Series, which, in my opinion, is of Lower Jurassic Age. Formerly the bed was believed to be Triassic, but the discovery in it of a true Crocodile (*Notochampsa*) seems to show that we should regard it as Lower Jurassic. And this discovery of a Predentate Dinosaur seems to confirm the conclusion. Even considering the sandstone as Lower Jurassic, *Geranosaurus* would still be the earliest known member of the Predentata.

All the specimens are in the palæontological series of the South African Museum, except those represented in figures 2, 3, 5, 18 and 23, which are in the Government Museum, Bloemfontein.

LITERATURE.

In Baron von Huene's recent magnificent work, "Die Dinosaurier der Europäischen Triasformation" a full list is given of the literature of the South African Stormberg Dinosaurs and of the allied forms of Europe and America.

REFERENCES TO PLATES.

Plate XIV.

Fig.

1. Left side of pelvis of *Gryponyx africanus*. × ·16.
2. Outer view of left femur of *Gryponyx africanus*. × ·15.
3. Posterior view of left femur of *Gryponyx africanus*. × ·15.
4. Outer view of left tibia of *Gryponyx africanus*. × ·15.
5. ,, ,, fibula of *Gryponyx africanus*. × ·15.
6. Right pes of *Gryponyx africanus*. × ·29.

Plate XV.

7. Left manus of *Gryponyx africanus*. × ·39. The hand is represented with the bones of the forearm and digits lying in one plane. The carpal elements are placed in what appears to be the natural position.
8. Portion of manus of *Gryponyx africanus*, with the carpals represented in the position in which they were found.
9. Left 1st metacarpal of *Gryponyx africanus*. Nat. size.
10. Left 1st metacarpal of *Massospondylus carinatus*. Nat. size.
11. Left 1st metacarpal of *Massospondylus harriesi*. Nat. size.
12. Left 1st metacarpal of *Ætonyx palustris*. Nat. size.

Plate XVI.

13. Left humerus of *Massospondylus harriesi*. × ·54.
14. Distal end of humerus of *M. harriesi*. × ·65
15. Left ulna of *M. harriesi*. × ·71.
16. Left radius of *M. harriesi*. × ·71.
17. Left manus of *M. harriesi*. × ·66. The hand is represented with what appears to be the natural position of the bones when the limb rested on the ground. The metacarpals and the penultimate phalanges of the 2nd and 3rd digits are considerably foreshortened.

Plate XVII.

18. Right pes of *Massospondylus harriesi*. × ·35.
19. Right scapula and coracoid of *Ætonyx palustris*. × ·38.
20. Right humerus of *Ætonyx palustris*. × ·41.
21. Right radius of *Ætonyx palustris*. × ·41.
22. Distal portion of right ulna of *Ætonyx palustris*. × ·41.
23. Left manus of *Ætonyx palustris*. × ·42.
24. Imperfect lower jaw of *Geranosaurus atavus*. About nat. size. The predentary is seen in front.